

WHAT IS CLAIMED IS:

1. An image reading apparatus which reads
a fingerprint image, comprising:

5 a roller rotatably mounted to the image reading
apparatus, a given pattern being printed on part of
an outer surface of the roller in a circumferential
direction;

10 a line sensor including a plurality of image
pickup elements which read a fingerprint image from
a finger that touches with the roller as well as the
pattern printed on the roller;

15 a generating unit which generates a reference
value to each of the image pickup elements correspond-
ing to part of the line sensor, which reads the
pattern, based on image data of the pattern read by
the line sensor;

20 a rotation sensing image extracting unit which
extracts a rotation sensing image based on the
reference value generated by the generating unit; and
a determination unit which determines capture
timing of the fingerprint image read by the line sensor
based on variations in the rotation sensing image
extracted by the rotation sensing image extracting
unit.

25 2. The image reading apparatus according to
claim 1, wherein the pattern has a plurality of
segments formed at a same angle with respect to

a rotation axis of the roller, and the segments are arranged such that an image of one end of a segment and an image of another segment are simultaneously read by the line sensor.

5 3. The image reading apparatus according to claim 1, wherein the generating unit generates maximum and minimum pixel values of pixels read by the line sensor so far in accordance with rotation of the roller as a reference value for each of the image pickup
10 elements of the line sensor.

 4. The image reading apparatus according to claim 1, further comprising a rotation direction determining unit which determines a rotation direction of the roller based on the variations in the rotation
15 sensing image; and

 an image recording unit which records an image with the capture timing determined by the determination unit in accordance with the rotation direction determined by the rotation direction determining unit.

20 5. An image processing apparatus comprising:
 a line sensor including a plurality of image pickup elements;

 a pixel value detecting unit which detects a first pixel value and a second pixel value from each image
25 data including a plurality of pixels output from each of the image pickup elements;

 a pixel value range detecting unit which detects

a pixel value range between the first pixel value and the second pixel value detected by the pixel value detecting unit;

5 a normalized data generating unit which generates normalized data that indicates a ratio of a pixel value of each of the pixels of the image data to the pixel value range;

10 a normalized data average calculating unit which calculates an average of the normalized data generated by the normalized data generating unit; and

15 a pixel value correcting unit which corrects a pixel value of each of the pixels of the image data based on the average calculated by the normalized data average calculating unit and the pixel value of each of the pixels.

20 6. The image processing apparatus according to claim 5, wherein the pixel value detecting unit detects a maximum pixel value and a minimum pixel value from the image data output from each of the image pickup elements as the first pixel value and the second pixel value, respectively.

7. The image processing apparatus according to claim 5, wherein the pixel value detecting unit includes:

25 a designated value recording unit which records a designated value that indicates an order of the pixels of the image data output from the image pickup

elements;

5 a first detection unit which detects a pixel value of a pixel of the image data output from the image pickup elements as the first pixel value, the pixel value being a designated-manieth largest one recorded by the designated value recording unit; and

10 a second detection unit which detects a pixel value of a pixel of the image data output from the image pickup elements as the second pixel value, the pixel value being a designated-manieth smallest one recorded by the designated value recording unit.

8. The image processing apparatus according to claim 5, wherein the pixel value detecting unit includes:

15 a designated value recording unit which records a designated value that indicates an order of the pixels of the image data output from the image pickup elements;

20 a first setting unit which sets an average of pixel values from a maximum pixel value to a designated-manieth pixel value recorded by the designated value recording unit in the image data output from the image pickup elements as the first pixel value; and

25 a second setting unit which sets an average of pixel values from a minimum pixel value to a designated-manieth pixel value recorded by the

designated value recording unit in the image data output from the image pickup elements as the second pixel value.

5 9. The image processing apparatus according to claim 5, wherein the line sensor is fixed in a transparent, hollow roller that is rotatably mounted to the image processing apparatus.

10 10. The image processing apparatus according to claim 9, wherein the line sensor reads a fingerprint image of a finger that is in contact with the roller.

11. A fingerprint recognition apparatus comprising:

15 a line sensor including a plurality of image pickup elements which capture fingerprint image data for each of a plurality of pixels;

 a pixel value detecting unit which detects a first pixel value and a second pixel value from the fingerprint image data captured by each of the image pickup elements;

20 a pixel value range detecting unit which detects a pixel value range between the first pixel value and the second pixel value;

25 a normalized data generating unit which generates normalized data that indicates a ratio of a pixel value of each of the pixels of the fingerprint image data to the pixel value range;

 a normalized data average calculating unit which

calculates an average of the normalized data generated by the normalized data generating unit;

5 a pixel value correcting unit which corrects a pixel value of each of the pixels of the fingerprint image data based on the average calculated by the normalized data average calculating unit and the pixel value of each of the pixels; and

10 a fingerprint recognizing unit which recognizes the fingerprint image data whose pixel value is corrected by the pixel value correcting unit.

12. The fingerprint recognition apparatus according to claim 11, wherein the pixel value detecting unit detects a maximum pixel value and a minimum pixel value from the fingerprint image data captured by each of the image pickup elements as the first pixel value and the second pixel value, respectively.

13. The fingerprint recognition apparatus according to claim 11, wherein the pixel value detecting unit includes:

20 a designated value recording unit which records a designated value that indicates an order of the pixels of the fingerprint image data output from the image pickup elements;

25 a first detection unit which detects a pixel value of a pixel of the fingerprint image data output from the image pickup elements as the first pixel value,

the pixel value being a designated-manifest largest one recorded by the designated value recording unit; and

5 a second detection unit which detects a pixel value of a pixel of the fingerprint image data output from the image pickup elements as the second pixel value, the pixel value being a designated-manifest smallest one recorded by the designated value recording unit.

10 14. The fingerprint recognition apparatus according to claim 11, wherein the pixel value detecting unit includes:

15 a designated value recording unit which records a designated value that indicates an order of the pixels of the fingerprint image data output from the image pickup elements;

20 a first setting unit which sets an average of pixel values from a maximum pixel value to a designated-manifest pixel value recorded by the designated value recording unit in the fingerprint image data output from the image pickup elements as the first pixel value; and

25 a second setting unit which sets an average of pixel values from a minimum pixel value to a designated-manifest pixel value recorded by the designated value recording unit in the fingerprint image data output from the image pickup elements as the second pixel value.

15. The fingerprint recognition apparatus according to claim 11, wherein the line sensor is fixed in a transparent, hollow roller that is rotatably mounted to the fingerprint recognition apparatus.

5 16. A method of processing image data which is captured by a line sensor including a plurality of image pickup elements and whose pixels each have a multilevel pixel value, the method comprising:

 detecting a first pixel value and a second pixel
10 value from the image data captured by each of the image pickup elements of the line sensor;

 detecting a pixel value range between the first pixel value and the second pixel value;

 generating normalized data that indicates a ratio
15 of a pixel value of each of the pixels of the image data to the pixel value range;

 calculating an average of the normalized data; and

 correcting a pixel value of each of the pixels of the image data based on the average and the pixel value
20 of each of the pixels.

 17. The method according to claim 16, wherein the pixel value detecting detects a maximum value and a minimum value from the image data output from each of the image pickup elements as the first pixel value and
25 the second pixel value, respectively.

 18. The method according to claim 16, wherein the pixel value detecting includes:

recording a designated value that indicates
an order of the pixels of the image data output from
the image pickup elements;

5 detecting a pixel value of a pixel of the image
data output from the image pickup elements as the first
pixel value, the pixel value being a designated-manieth
largest one recorded by the designated value recording
unit; and

10 detecting a pixel value of a pixel of the image
data output from the image pickup elements as the
second pixel value, the pixel value being a designated-
manieth smallest one recorded by the designated value
recording unit.

15 19. The method according to claim 16, wherein the
pixel value detecting includes:

recording a designated value that indicates
an order of the pixels of the image data output from
the image pickup elements;

20 setting an average of pixel values from a maximum
pixel value to a designated-manieth pixel value
recorded by the designated value recording unit in the
image data output from the image pickup elements as the
first pixel value; and

25 setting an average of pixel values from a minimum
pixel value to a designated-manieth pixel value
recorded by the designated value recording unit in the
image data output from the image pickup elements as the

second pixel value.

20. The method according to claim 16, further comprising capturing a fingerprint image by the line sensor.